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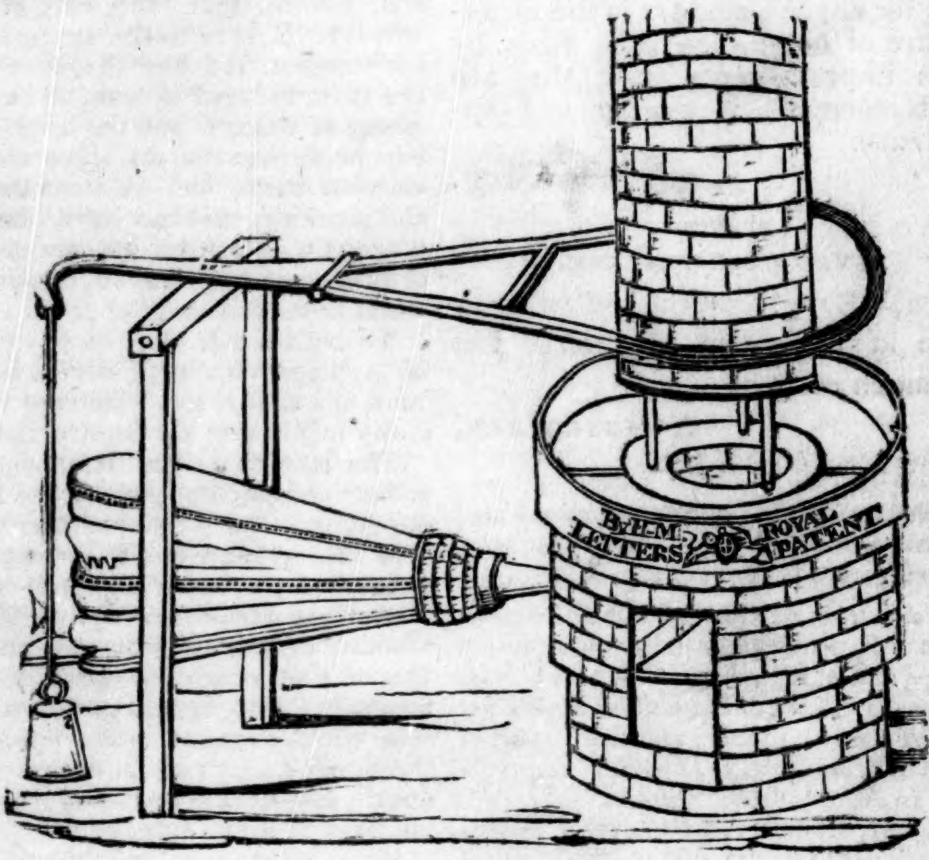
"The more widely Science is diffused, the better will the Author of all things be known, and the less will the people be 'tossed to and fro by the sleight of men, and cunning craftiness whereby they lie in wait to deceive—.'" *Mr. Brougham.*

SPENCER'S PATENT FORGE.



IT is presumed that the above Drawing of a patent Forge, to be used in nail-making and all other manufactories of iron or steel, is so plain as not to require any figures of reference.

Its advantages are, first, a considerable saving in the erection of buildings, and cost of bellows, fuel, &c. &c., as, with this forge, six men can be employed where only four could be by those ordinarily used. The arms of the bellows being circular, they command a steadier and stronger blast, and may be acted upon in front as well as the sides. The circular form of the fireplace, and in which the fire is confined, produces a considerable saving in fuel; and a grating at the bottom of it, by admitting a more free circulation of air, gives a quicker and better heat to the articles presented for fusion; and, lastly, this form also admits of charcoal being used, whereas, in an open fireplace, this is not practicable.

The combination of sulphur with pit-coal is so injurious to iron that it is recommended to manufacturers of iron articles to deprive it of this poisonous quality by coking; and in forges of the present description, if a portion of one quarter of charred wood is added to three quarters of charred pit coal, the articles to be wrought will acquire a considerable degree of ductility and stoutness, and look much finer and clearer on the surface than by any other method.

The patentee of this forge, whose name and house have stood pre-eminent for above a century in the manufacture of horse shoe nails, finds, by these improvements, that they are much enhanced in quality and appearance.

Lond. Mec. Mag.

NAVAL ARCHITECTURE.

Sir,—By giving the following a place in your useful Magazine, you will much oblige

A Subscriber.

New-York, Aug. 1, 1825.

Specification of the Improvements in Naval Architecture, made by John Thomas, *bearing date the 14th of April*, 1825.

Specification of a new and useful combination of improvements in the construction of ships and other vessels, of which I, John Thomas, a citizen of the United States, am the inventor, the whole and every part of which I demominate *Thomas's Improvements in Naval Architecture.*

In order, however, more clearly to specify and describe the said combination of improvements by me made, it is proper to advert to the defects of construction in the usual and prevailing mode of ship building, and to describe the ordinary and usual mode of construction. It is well known, that the timbers composing a ship's frame are usually placed across the keel in frames or bends, which are composed of two parallel and equally curved sections of the form, made from the moulds in several pieces, bolted together horizontally so that each joint shall be covered by the solid part of the other parallel piece, to break joints. These frames are then erected, and placed transversely to the keel, at a little distance from each other, leaving a space of some inches between them. Then a stout plank, called the clamp, is secured to the side, or to the frames, for the beams to rest on, and after the ceiling is put in, the beams are secured to the sides of the vessel by the knees;—the lodging knee horizontally over the clamp and ceiling; the hanging knees vertically over the ceiling also. The bolts pass, 1st, through the knee—2d, the ceiling and clamp—3, the timbers—and 4th, the external plank. Thus, eight surfaces of wood, all liable to shrinkage, are between one extremity of the *bolt* and the other; which bolts tie the deck to the sides, and, in fact, sustain the action of the ship in her rolling motion at sea. It is well known, that this part of a ship, which requires to be the strongest, is thus the weakest. It is here the *seams* and *butts* are most inclined to open, and admit the causes of decay; and the transverse timbers being placed apart, there are cavities between them, and between the ceiling and planking, that can never be cleaned out, and they always become receptacles of filth, generating foul air, equally prejudicial to the ship and her crew.

To explain still more clearly the object of my improvements, I advert to the motions of a ship at sea, which are to be specially regarded in her construction.

The ship at sea has the movements of rolling and pitching; and when the sea is oblique, also one compounded of both.

In rolling, the stress is principally on, or in that portion of the hull which is above the centre of gravity. The weight, whether of cargo or guns, and the momentum of that weight, are sustained, in this alternate action, by that portion of a ship's side which connects to the opposite side, through the intervention of the beams and deck. Experience shows abundantly the tendency in ships, especially ships of war, to strain, open, leak, and decay, along the waterways, gunwale, and waist.

The pitching motion of a ship at sea has a tendency to strain her along midships, producing the effect termed hogging.—This tendency is of course more difficult to resist, in proportion to the length and burthen of ships. Vessels are necessarily made more or less sharp forward, and lean aft, that they may steer well. The head and stern thus built are not supported by the water, but are supported by their connexion with the centre, where the principal buoyancy of the ship resides, and co-operates with the unsupported weight of the extremities, to produce a shape, described as an upward curve (of the deck.) This tendency is greatly increased in vio-

lent pitching, as the middle is borne suddenly up, and the extremities left as suddenly unsupported; her plunging and rising produces the opposite resistance alternately. Under these circumstances, a ship is said to *strain* and labour; the butts of the planking become a little separated; the general working of the pieces and joints loosens the oakum, and the ship becomes leaky. It is thus in gales of wind that ships spring aleak, or start a butt and founder.

It is the part of wisdom to profit by experience. All nautical men know the defects of ship building in the common and usual way; the want of union in her constituent parts; of snpport to the extremities from below the line of flotation; of connexion in the planking; and of firmness in the connecting together of the beams, knees, and sides.

Experience has enabled me to invent the remedy for all these defects of construction. Having been employed in the naval ship yard of Plymouth, in England, for twenty-five years, bred to the business of building and repairing ships of war, and promoted to the rank of an inspector in the dock yard, no man could have had better opportunities of perceiving the defective system of naval architecture, not only in the British navy, but among all those nations with whom Great Britain was at war most of that time, and from whom ships were captured.

Moreover, I am perfectly well acquainted with the successive improvements of Sir Robert Seppings, Mr. Walters, and others; and that the expedients suggested by the former have not prevailed in practice. The former, by filling the space between the timbers with wedges, hogged the ship in the very process, and the substitute of mineral tar and sand had no other effect than to add weight to the bottom. The diagonal riders and trusses of Mr. Seppings, however pleasing or promising in appearance, could not strengthen a ship without union, which, in fact, the plan did not admit of. A new device is not always a new improvement. Utility must be demonstrated on principle to constitute one. And this I shall endeavour to do in describing my system of naval archicture.

I specify as my improvements combined—

First, my frames in the vertical position.

Secondly, my frames in the horizontal position.

Thirdly, my method of *filling* between the fore and aft frames.

Fourthly, my iron binders of the frame.

Fifthly, my dowelled waterways and dowelled strakes.

Sixthly, my notched and jogged planking.

Seventhly, my capstan-headed rudder.

These inventions, superadded to so much as may be used of the common and usual method of ship building, constitute my combination of improvements in naval architecture. I proceed specifically to describe the manner of constructing them, and the principle of their effects in giving great and unusual strength to the hulls of vessels throughout their fabric.

The object of my *vertical frame* is, to unite the beam to the frame itself, without the intervention of the ceiling, and without passing the fastenings of the knees through the external as well as internal planking.

This method avoids so many surfaces of wood bound together, as before described, and enables me to have no more vertical frames than there are beams: and to leave out the filling timbers, which are unnecessary in the position they occupy, rather hanging to the plank than supporting them, and, instead of this useless multiplication of crooked timber, (which is much the most expensive part of the material,) to throw less expensive materials into a position in the fabric, where they contribute even more to the strength of the ship, and permitting me to relinquish the inside planking, and avoid the formation of cavities.

The position of the material above alluded to is horizontal, or fore and aft, and denominated my *horizontal frame*. The horizontal frame is *external* to the *vertical frame*, and is in two parallel pieces, but the pieces constituting it are not butted, but scarped with a notch scarp, and each scarp dowelled, whereby each and every one becomes a continuous tie from the stem to the stern post. Along the midships they are parallel, but necessarily converge and come together at the ends, which ends are there strongly secured through the apron, or inner stem, and through the inner stern post; and being bolted to each of the vertical timbers, the frame of the ship becomes a combination of vertical arches and horizontal arches, the buttresses of the latter being the stem and stern post. The effect of this system of framiming, obviously, is the complete union of the frame. The resistance to outward pressure on the bilge

at midships, is resisted at the stem and stern post, and is supported likewise from the opposite side.

The vertical frames help to sustain the horizontal, and the horizontal are a protection to the vertical. The diagonal direction they necessarily take towards the extremities, give upward support to the head and stern, from below the line of flotation. And still to make it impossible (nearly) for the frame to alter its shape, I fill the spaces *between the horizontal frames*, which are in large ships, perhaps, eight inches apart, accurately, with some light durable wood, as *white cedar*, fastened to the vertical frames. These seams being caulked from within and from without, the ship is already tight and strong.—But I am providing for the strength required in *ships of war*, as well as others; and, therefore, next describe the *planking*, or sixth of these combined improvements, in the words of my patent for hooking and jogging plank, bearing date the 2d of December, 1822, as follows:—

"The planks, or thick stuff, which compose the sheer streaks, channel wales, main wales, diminishing stuff, clamps and spiketings, differ from the common mode of planking as follows:—All the butts, except the fore and after, and where the edges are required to work fair, are to have about one inch rising wood, forming towards each end hooks or jogs. These hooks or jogs should not be less than four feet, but as much longer as the plank will admit.—The length of the hooks, or jogs, as described, is supposed to be in plank of twenty-four feet in length; if the planks should work longer, the hooks or jogs should be proportionally longer. When one streak of plank is fastened to the ship's side, prepared in the manner before described, it will be necessary to take off, on a rule, or spiling staff, the jogs or hooks, and transfer them to the plank which are to come next, and thus will be formed in the *second* streak recesses to receive and embrace the hooks or jogs formed in the first streak, so that by pursuing this method all the plank, as before described, will be connected, supporting and bracing each other. The method to be pursued or observed to lay off my mode of planking is, to set off, on the side of the ship, *lines* resembling the common mode of planking. These lines are to to be shown with chalk. The next thing to be done is to set off the butts, which must be regulated according to the length of the plank provided for the purpose. When the butts are marked on the timbers, set off the jogs, or rising wood, as before described; when this is done, race, or scratch, on the timbers, all the hooks, or jogs; this being done, rub out all the chalk lines resembling the common mode of planking, and my mode of planking is clearly and accurately laid off. The projecting wood, forming the hooks or jogs, may be more or less than one inch, and made water-tight by the common mode of caulking."

The above described mode of planking obviates the dangers and disadvantages of the *butts*, in the common manner of planking, as this method prevents their separating—all the planks co-operating by this union among them, to tie the extremities of the ship together.

But in order to give complete solidity to the bottom, to the exclusion of air and water from between the planking and horizontal frames, the latter is first payed with pitch, and covered with tarred paper, or preferably with tarred flannel; then the plank, being previously steamed and payed also with tar, are drawn by trenails, and spikes, into complete contact. And if the farther precaution is thought necessarya stran of oakum may be laid or chinced into the upper inner edge of the streak, which may be champhered for that purpose. When once well planked, this form of ship building is too perfect to leak from any common causes and wear of the ship. She may require no recaulking, until the oakum itself decays, unless from shrinkage in the upper works.

But to return to the manner of executing the work in the horizontal framing of that part of the bottom next the keel or hog piece. One, two, or three of the fore-and-aft frames next the keel are in contact, and connected by large and stout bolts, which pass horizontally through them, and the *hog piece*, which is the midship deadwood. The keelson, which is above the floor-timbers of the vertical frames, being bolted perpendicularly through in the usual manner.

The fourth improvement of the combination is denominated the iron Binders.

These are of flat iron, three inches broad, and 5-8ths thick, (for a frigate,) welded into one length, let in flush, passing vertically from each port timber to the lower fore-and-aft frames, which, being previously bolted together through the keel, the frame is bound together, as with hoops. These binders, punched or drifted, will each take *three* bolts in the top timbers, *one* bolt in each horizontal timber, and *two* in the lower one next the keel.—The binders do, in fact, supersede the ne-

cessity of bolting the two contiguous parallel parts of the horizontal frame together; and as those bolts would be across the caulking, they might, in a degree, interfere with the caulking irons. But the same objection does not apply to dowelling them.

My fifth improvement is in the *dowelled waterways* and *streaks*. The object of this is to give peculiar strength to the connexion of the *deck* with the *sides* of the ship.

The top timbers will have been previously scarped and bolted to the horizontal timbers. In frigates, the scarp will be about eight feet in length, and two inches in the lower end.

In order to give proper room for my dowelled waterways, I give the beams a greater curve or round than is usual; for example, in a large frigate, *four* inches more, that, without making the *deck* more round, I may lay a deeper waterway, and have the next three or four streaks of the deck *eight* inch plank instead of *four* inch plank, as they usually are.

It is well known, that *waterways* occupy the angles made by the beams with the sides, and on the upper deck form an acute angle, by the joint effect of the curve of the beam, and the inward receding of the top timbers. It is no easy matter, therefore, to secure the waterways with dowels to the beams only, and still more difficult to secure them also to the timbers, or double dowel them. This, however, I do in a way and manner that has never been before known and used. It is effected by reversing *the order* of the work. I *first secure* the waterway to the side timbers, (into which I have inserted the dowels, which are generally of lignum vitæ, exactly turned to fit their sockets or stations,) *then* fit the dowels to the *under* side, and the corresponding socket in the beam to be placed, (which socket is one third the diameter of the beam, and the dowel three inches long,) then the beam being made of the exact length required, is brought up to its place, and the dowels in the under side waterways enter the sockets of the beams. The clamp piece (usually put on first) now follows up the beams, and is secured to the side timbers. Thus the *waterway is double dowelled*, and secured in the most perfect manner, notwithstanding its angular shape.

This method is applicable and requisite to the upper deck of a frigate, and line of battle ships, and all ships and vessels, whose waterways must occupy an acute angle.

In like manner I dowel the contiguous streaks of the deck before mentioned, as made uncommonly thick. The process of dowelling is by means of an instrument called a dowelling bit. The dowel generally enters one and the other surface, each an inch and a half; and the effect is to tie powerfully the beams together. But still more and better to secure the co-operation of the said thick plank and waterways I jog them together, as before described in my method of planking; and, in order that the caulking may be more effectual, I rabbet these thick plank four inches down, one inch lap, for the purpose of stopping the oakum in caulking.

Finally, I bolt the *thick plank waterways*, *top timbers*, and *wales*, horizontally together, (if a frigate, with 1 1-4 inch bolts, 12 inches apart,) throughout the whole length of the ship, with the additional improvement of a *flat ring* under the *head of every bolt*, as well as under the rivetted end, in order that the stress in the rolling motion shall be upon a larger surface of wood than it would in the usual way without rings, the heads of the bolts being at the wales, or outside.

This method is not only much stronger, but saves the expense of the lodging knees; and thus the part of the ship which is commonly the weakest, and most liable to open and decay, is made at least as strong as any other part.

In ships of war of the largest size, I increase their strength still more, by a very simple and novel method, viz.: by placing *braces* between the vertical frames. The material thereof may be merely plank of three or four inches thickness. It will be recollected, that my vertical frames are three feet apart; between them I place these braces, first horizontally, viz,: pieces of plank dowelled to the fore-and-aft frames. I then place others, likewise dowelled, at an angle of 45°, sloping upwards, from the centre towards the stern, and forward from the cetre towards the head of the ship.

Thus, in ships of war, I deem it expedient to employ this combination of means of strength, although in ships of smaller dimensions, some of them may be dispensed with, especially the latter.

In ships of war, *the thickness of the horizontal frames* will, for frigates, be obout nine and a half inches thick; in line-of-battle ships, eleven inches. These frames are got out, like the others, to moulds, and precisely fit, in the natural position of the fibre, the curve to which they are applied; consequently, the safety of the ship does

not depend on single plank, which have been twisted and wrung into shape by steam and by force, having always a tendency of its own, independently of the stress arising from the motion of the ship, to spring off at the butts.

The principle of this system of naval architecture, is the combination of the means herein described, of improving the strength solidity, and durability of ships, and other vessels, not meaning to include, but superadded to, so much of the common and usual mode of building as may be employed therewith, and in the distribution of materials.

And, besides the advantage of great strength, from the distribution of the materials in such manner as to meet and resist the stress and strain, on established principles of mechanics, there is found economy therein, from the diminution of the quantity of crooked timber otherwise required, which is always the most expensive. The ship is more durable from being free from inaccessible cavities and vermin, and of a more solid and impervious construction as to the water; while the air has access freely to her main vertical frames, and to the interior of the whole fabric. The danger from ice, from *secret leaks*, hid by the ceiling, and from external injuries, is greatly diminished; and in *repairs*, much saving is to be expected from this method; so likewise in avoiding average losses from damaged cargoes in merchant ships. The thickness of a ship's bottom, of three hundred tons, will be *ten* inches, instead of two and a half or three inches; and steam boats will be made much stronger and safer in this way or manner of building than heretofore.

My seventh improvement here combined is, the *capstan-headed rudder*, which to explain, it is necessary to describe the form of the rudders in common use, viz.; the square-headed straight rudder, and round-headed crooked rudder, whose centre is in a line with the centre of the pintals, and whose round part above the upper pintal is about one-fourth the length of the whole rudder.

The old straight rudder is objectionable on account of the *largeness* of the rudder-hole through the counter, which requires about ten inches on each side, usually covered with a canvass coat, liable, however, to be carried away, and to admit the sea when the ship is before the wind. The circular-headed rudder, which has very much obtained in practice, was intended to remedy this defect; but the objections to this are, that the rudder head and shaft are too small for the tiller, and the head thereof is too weak; besides that the upper pintal is necessarily three feet lower down, on account of trimming away the head of the stern post in a line with the pintal, consequently, the upper third part of the rudder is unsupported, and when the ship heels, its weight, with the weight of the tiller, causes it to bear severely on the pintal, which is therefore apt, in rough weather, to give way, when the rudder may become unmanageable. Furthermore, the round-headed rudder is much weakened by letting in the upper pintal about seven inches, to range with the centre of the round shaft; thus, it sometimes occurs, that rudders of ships of the line are in this part but *nine inches* through of solid timber, which is hazardous. Another objection to the round-headed rudder in ships of war is, that in case the tiller is shot away, there is no means of securing it in midships while another is replaced. In the square-headed rudder, this difficulty is provided for by chocks, which wedge it firmly midships. Again, from the circular shape of the head, the *mortise* takes away too large a proportion of the timber, compared to what would be left on a square head, as the tiller of a ship of the line should be 14 inches by 10 inches, which takes away too great a proportion of a round head of two feet diameter.

My improvement in the rudder consists in this: That on my rudder head, which is a straight main piece running down into the body of the rudder, I place and secure the lower half part of an *iron coupling*, to which an upper half part of the same size corresponds, as it were, at the foot of a capstan shaft, around which a drum head is formed in the manner of a capstan, rising above deck. The *tillers* enter this *drum-head*, which is about three feet diameter, made of live oak plank, strongly hooped and secured to the flat circular plates at its extremities, as is usual in making a capstan. It consists of two parts, one above and one below deck, joined by a shaft, which is in a line with the pintals. Immediately above the deck there are *partners*, which clasp the shaft as in the instance of a double capstan, and above at the partners is a brass bearing box, which corresponds to an enlargement of the shaft, whereby the weight is sustained; and by screwing up the screws of the *coupling* the rudder is lifted, and the friction is taken off the rudder braces. The manner of firmly securing the rudder head to the

lower coupling box is by means of *ears*, whose bolts pass transversely through the rudder head.

To secure the rudder in midships, in case of losling the tiller, I place a semicircle of *cast iron*, with stop-jogs in the forward part of the partners, into which, on each side, two *palls*, fixed to the drum-head, drop; and the rudder, on coming to midships, is secured by them.

The whole drum is within the rudder case, and it exactly fills the rudder hole, as the round-headed rudder does. The advantages are, that it is safer in all respects, and requires less force or power in steering.

Furthermore, as a greater security in time of action, I make an iron external tiller, for which the mortise is made about three feet from the head of the rudder, about nine feet long, from which two luff-tackles are led from the tiller to an eye-bolt in the buttock. On each side is a fixed leading block, in the counter, through which the fall is led to the gun-room.—this iron tiller is intended as a preventer in time of action, in case of losing the tillers on board.

Witnesses to the signature of
JOHN THOMAS.

Wm. Elliot, }
Wm. P. Elliot, } *of Washington.*

Specification of patent granted to John Thomas, *for his invention of Lifting Blocks, for the repairs of ships, &c. containing a description, in the words of the said* John Thomas *himself, of his improvement in Blocks and Wedges, for raising vessels, and for other uses in ship building.*

Blocks in common use are of one, two, and sometimes three solid square logs, making in all about two feet in depth, and about seventeen inches broad.

My blocks are composed of two pieces, ten inches thick, seventeen inches broad, and five feet long, and two wedges, each eight inches broad, six feet six inches long. The upper part of the lower block, and the lower part of the upper block, have an inverted inclined plane of about five degrees inclination. The inclined planes form a guide for the wedges, which are applied at each end; and when placed under a ship, are driven in, or driven back, by two battering rams. The battering-rams are made of live oak, about nine inches square at the large ends, tapering to six inches, and twelve feet long.

Note.—All the dimensions here given may be a little altered, without either much injury or improvement to the blocks and wedges here described—which I should not consider any invention, but as interfering with mine.

JOHN THOMAS.

Witnesses.
Wm. Thomas.
Hy. Sleir.

ON NATURAL STEEL, OR GERMAN STEEL.

Three sorts of steel are usually distinguished: the steel of cementation, often called blister steel, because its surface is usually covered with blisters; cast steel, formed from the former by melting in a crucible; and lastly, natural steel, or that of the forges, very frequently called German steel.

This steel is the most impure, unequal and variable of the three kinds, but it is considerably cheaper; it has also the property of being easily welded, either to iron or to itself, and some other qualities which render it frequently preferable to the other two kinds of steel.

Its grain is unequally granular, sometimes even fibrous; its colour usually blue; it is easily forged; it requires a strong heat to temper it, and it then only acquires a midling hardness; when forged repeatedly, it does not pass into iron so easily as the other kinds.

There are two subdivisions of this steel; that procured from cast iron, and that obtained at once from the ore.

The steel yielded by cast iron manufactured in the refining houses, is known by the general name of furnace steel; and that which has only been once treated in the refining furnace, is particularly called rough steel, and is frequently very unequally converted into steel. Both these varieties are drawn into bars, then hardened, and broke into pieces.

The best cast iron for the purpose of making natural steel, is that obtained from hematites or from sparry iron ore; if it contains magnesia, this is thought to be of advantage; it should be of a gray colour; white cast iron does not yield steel unless its charge of carbon is increased, either by stirring the melted metal with a long pole, and keeping it melted a long time, that it may absorb charcoal from the lining of the furnace; or by melting it with dark coloured iron. Black cast iron yields a bad brittle steel, unless the excess of carbon that it contains is either burnt away, or it

is melted with finery cinder. The cast iron, to be converted into steel, is then melted in blast furnaces, and treated nearly the same as if it were to be refined into bar iron, only the blast is weaker; the twyer, instead of being directed so as to throw the wind upon the surface of the melted metal, is placed nearly horizontally; the melted metal is kept covered with slag, and is not disturbed by stirring;—when judged to be sufficiently refined, and is grown solid, it is withdrawn from the furnace and forged. After this natural steel is made, there is almost always taken out of the refining furnace, towards the end of the operation, one or more pigs of iron; which are rather hard, and used for implements of husbandry.

That is the best natural steel which is the densest—becomes the hardest when tempered, and is not brittle. Its grain should be very fine and equal; and it should be capable of being forged and welded without breaking or splitting;—lastly, it should support the action of the forge well, without changing its nature.

Natural steel has in general the defect of being strawy, or containing parts which are not steel, but merely cast iron, sometimes it is cindery, its surface being covered with small holes; but this seems merely accidental, and owing to its being treated with too strong a heat. It is in order to remedy these defects that this steel is bundled together and forged.

The most esteemed natural steel, made in Germany, is that of Styria; it is usually sold in chests or barrels, two and a half or three feet long. Its grain is even, close and fine; but when polished, it shows fibres, cinders and threads, from which even this steel is not entirely free. Sometimes when broke it has in the middle of the fracture a spot, yellow, orange, or blue, which is called the rose, and the bars in which it appears are called rose steel. It has been thought that this rose was a mark of goodness, and the manufacturers of steel in other places have attempted to imitate it; but, in fact, this rose is a sign of defect, and is only found at the place where the bar breaks with the greatest ease; indeed, it appears to arise from a straw which is formed at the time of tempering the steel. Files, and the best kinds of tools, are usually made of this steel in Germany; the proper colour for hardening it is a cherry-red heat.

The next esteemed steel is that called distinctively German steel, or Pont stuff. It is not so good as the former; it is sold either in bars ten or twelve feet long, or in barrels about three feet long; it is marked with an anchor, or seven stars in a circle. This is the most used.

There is also a steel in Germany called Cologne steel, forged in bars 3 inches .5 long, 1 inch .25 wide, and 0 inch .75 thick. Solingen steel. Hungarian steel, marked with an oak leaf, and sold in bundles of four or six bars, fastened together with iron bands; the bars are of different sizes, but 1 inch .25 square.

Lond. Mec. Jour.

MANUFACTURE OF SUGAR OF LEAD.

It is well known, that according to the best analysis, the acetate of lead is composed in round numbers, of 58 parts, in 100, of oxide of lead, 26 of acid, and 16 of water Of course the saturating power of the pyroligneous acid intended to be employed must be examined, in order to determine how much of it answers to 26 parts of the dry acid. When this acid is at forty degrees of the acidemeter, it generally requires 68lbs. of it to be poured on 58lbs. of litharge. The solution takes place immediately, and is so quickly made, that a considerable heat is produced, which retains the sugar of lead in solution; but a little fire is usually given, and some water added, to keep up this solution until the liquor has become clear, and it is then poured into crystallizing pans.

The crystals, which usually weigh 75lbs., are produced in about thirty-six hours: they are drained and carefully dried. The mother-water, which contains about 25lbs. of the sugar, by evaporation yields great part of its contents; but the crystals are by no means so fine as the former When the mother waters no longer yield crystals, they are mixed with salt of soda, when a carbonate of lead falls down, and acetate of soda remains in solution. The carbonate of lead may be used instead of litharge, in future operations.

It will be found preferable at first to add the mother-water to the acid and litharge, and thus near 100lbs. of good sugar of lead will be obtained instead of 75lbs. by the first crystallization; but this method cannot be continued for any time, as the liquor

will become greasy, the crystallization will be hindered, and the sugar of lead become difficult to drain; so that it is then necessary to abstain from adding the mother-water any longer to the solution, and to decompose it by salt of soda.

The acid ought to be pure, and particularly free from tar and sulphurous acid; the tar would discolour the sugar of lead, and the sulphurous acid produce an insoluble precipitate of sulphate of lead.

The boiling solution may be brought to various densities, by adding more or less water; and as this difference produces some variety in regard to the crystals, the manufacturer, by a little observation, may suit the taste of his customers.

To obtain a very white sugar of lead, the metal of litharge should have no admixture of copper, as is usual in French lead and German litharge. Its effects may, however, be obviated, by putting a few plates of lead into the boiler. But some manufacturers do not wish to separate the copper, because it gives the sugar of lead a slight bluish tinge, which pleases the eye of many of the buyers.

In this solution of the litharge in the acid there remains a very small residuum, which ought not to be flung away; but when a quantity of it is collected, it may be treated as an ore of silver, as it is composed of that metal, united with oxide of copper, of lead, and some earthy substances.

It is a great advantage in this manner of forming sugar of lead, by means of strong pyroligneous acid, that it is not necessary to evaporate the solution for the purpose of crystallizing it, as was necessary when vinegar was used; for the solution is decomposed by being boiled, and part of the sugar of lead is changed into white lead, and, of course, separates it in form of a powder. *ib.*

ON THE MECHANICAL POWER OF HUMAN LABOUR.

Several authors have investigated the force of mankind as exerted in various kinds of labour. The investigations of the earlier observers have, however, been generally obtained from casual observations, without any regular course of experiments.

Amontons says, a man, weighing 133lbs French weight, was completely exhausted in ascending 62 feet by steps.

He also says that a sawyer made 200 strokes, of 18 French inches each, with a force of 25lbs. in 2 minutes and 15 seconds.

According to Desaguliers, an ordinary man can turn a winch, with the force of 30lbs. at the velocity of 30 inches in a second, for ten hours. And he observes, that two men working at a windlass, having two handles at right angles with each other, can raise 70lbs more easily than a single man can the 30lbs.; as an additional effect of 5lbs. is produced on the work of each man, in consequence of the uniform action arising from the handles being placed at right angles with each other.

According to the same author, the action of a fly, when the motion is pretty quick, increases the force of a man so much that he can exert the force of 80lbs.

And he farther says, that with a good pump, a man may raise a hogshead of water 10 feet high in a minute, and continue at this work for a whole day.

Dr. Robison says that a feeble old man, by walking backwards and forwards on a lever, raised 7 cubic fet; that is to say, 437lbs. and a half of water 11 feet and a half high each minute, for 8 or 10 hours a day; while a young man, weighing 135lbs and carrying a load of 30lbs. raised 9 cubic feet .25, equal to 578lbs. 1 of water, the same height, in the same time, and for the same continuance without being fatigued.

Euler thinks a man can raise 1000 lbs. 180 feet in 60 minutes.

According to Bernouilli a man can raise 60lbs 1 foot in a second, and continue this for eight hours.

Desalguliers said a man may raise 1000lbs. 330 feet in 60 minutes, but Smeaton assigns only 2.5 feet for the height that a man can raise that weight in the given time.

The raising of 30lbs. 3 feet and a half in a second, for 10 hours, is esteemed, by Emerson, the strength of a man; while Schultze, the German writer on mechanics, lessens this force nearly one-third, by giving only 2 feet .43 as the height to which a man can raise 30lbs in a second; and thus affords another instance of the very inferior strength of the natives of Germany. *ib.*

ON TRACING BY MEANS OF OILED SILK.

The common methods of tracing drawings by placing a light behind them, or by rubbing the back with black lead dust, or red chalk in powder, are well known; as is also the tracing of a drawing by means of paper rubbed over with a mixture of equal parts of nut oil and oil of turpentine, and dried immediately by means of flour.

Another method has also been practised, by which not only an exact outline may be obtained, but also a reverse; which is of great use to engravers. The substance used for this purpose is white oiled silk, which ought to be as transparent as possible, and cut to the size of the drawing.

The oiled silk being laid over the drawing, the outlines are drawn with common writing ink, slightly gummed, or which is still better, well sugared, as ink is prepared for copying-presses

When the tracing is finished, a sheet of moistened paper may be laid on the tracing, and one or two sheets of dry paper, all which are to be firmly fastened. The upper sheet being then well rubbed with the hand, or an ivory ball rolled about over them with as much force as the hand can give, a very exact reverse will be obtained with great ease.

For the obtaining of a very exact tracing, the drawing should be traced twice, and on both sides of the oiled silk, with this precaution: the tracing must be performed first with red ink, and the oiled silk being then turned, a pen, with black ink is taken, and all the red ink lines are again traced over afresh. It is necessary to take the precaution of making the first tracing with red ink, that the traces of one surface may not be confounded with the other, and any of them forgotten, which might happen by reason of the transparency of the oiled silk.

When either the tracing or the reverse has been transferred upon the paper, and, of course, the tracing itself on the oiled silk becomes useless, it may be taken off with great ease, by rubbing the oiled silk over with a brush dipped in water soured with aquafortis or spirit of salt, which takes off all the traces either of the red or black ink; after which the oiled silk is to be washed with clean water, and may be used again repeatedly. *ib.*

CAUSE OF THE DIFFERENT TASTE OF PORTER MADE IN LONDON AND PARIS.

The French brewers have attempted to imitate the London porter, by hiring brewers from the metropolis to brew there; but however carefully these have exerted their talents, they have not been able to brew a porter exactly similar in taste to the London; and the savans of the French capital have been puzzling their brains to determine the cause of this failure.

Mr. Francoeur, professor to the faculty of sciences at Paris, imagines, for what will not man imagine that the peculiar taste of London porter arises from the smoke of our sea coal fires. He says, that the peculiar smell of the smoke of sea coal is so abundantly diffused in the atmosphere of London, and especially in those manufactories which employ great fires, and in their neighbourhood; and is so powerful and adherent, that in London every article is strongly impregnated with the smell of it. English cloth, packed in the metropolis, carries the smell into foreign countries; and the clothes of Londoners retain the smell for a fortnight after they have left their homes. Hence, he says, there is no wonder that the porter should taste of this smoke, especially considering how long the porter is exposed to the smoky atmo-

sphere, with a large surface in coolers of the brewhouses, whose steam engines emit such dense clouds of smoke. *ib.*

ON THE ORIGIN OF TRET.

The origin of tret is assigned to the difference between the tower and the avoirdupois weight; when this decrement was first allowed, it is probable that the tower or Saxon weight, of 15 ores to the pound, was used at the custom house; and as 104lbs. of that weight are equal to 100lbs. avoirdupois, of 16 ounces to the pound, the merchants were in the habit of thus reducing the weight as taken at the king's beam used by the revenue officers, into the avoirdupois or commercial weight, without the trouble of weighing the articles over again, an operation for which, it is probable, many were not provided with the necessary tackle. Since the disuse of the tower weight, the same reduction has been oontinued by habit. *ib.*

ON THE MANUFACTURE OF GERMAN PORCELAIN, OR CHINA.

Porcelain, or Chinaware, as it is usually called, is white, its grain is close and fine, and it has a certain degree of transparency; but the best kinds, as those of China and Saxony, are rather opaque, and possess, in a superior degree, the property of sustaining sudden changes of heat and cold.

It is very easy to render porcelain more transparent than ordinary, but it is not easy to render it opaque, and yet preserve its fine and close grain. The French seem to despair of making their caina of as good quality as those of China, Saxony, and Vienna, on account of their not being able to find a clay equal to that of those countries.

The porcelain clay, or kaolin, as the basis of china ware is generally called, from the Chinese name of the article, is a very dry clay, composed, like all other clays, of silica and alumina, but in nearly equal proportions of each. Its colour is a more or less pure white; and its resistance to the action of fire, by which it cannot be melted in the most violent heat of our ordinary furnace, is what particularly distinguishes it. But as it is necessary, for the fineness and closeness of the grain, that the china ware should undergo a beginning to melt, it is necessary to add some kind of flux to the kaolin, in order to form the paste from whence the china ware is to be moulded.

The fluxes employed are potasse or soda, or more commonly barytes, strontian, or lime; for it has been found, that all mixtures containing three of the earthy principles melt, at from 130 to 150 degrees of Wedgewood's pyrometer.

When potasse or soda are used for promoting the melting, a less quantity must be taken than when barytes or strontian are employed for that purpose; but the fluxes employed in Germany are almost always a carbonate of lime or sulphate of lime, by whose means, the paste being baked in the degrees of heat just mentioned, undergoes a kind of semi-vitrification, which gives it the necessary solidity. The sulphate of lime is only added when it is wished to save fuel, and render the ware more transparent than usual.

The kaolin, as well as the other substances which enter into the composition of the ware, must be purified with great care, by being ground, mixed with water, and passed through fine sieves.

When the kaolin and its fluxes, and the sand to be used, are well purified, they are mixed together, to form the paste for the body of the ware. The paste, thus prepared, is well beaten for a long time, until, when cut down by a wire, it appears perfectly close, and without the least air bubble. It is afterwards put into a damp place, and left there for some time; the longer the better. In China, it is said to be not uncommon for a father to lay by, for his son, as much of this paste as will last the son perhaps for his life. A kind of fermentation seems to take place, by which a combustible principle is destroyed, which would otherwise tend to colour the ware. The paste is then beat again, until perfectly solid and close, when it is formed into vessels, either on the wheel, the lathe, or other mechanical method.

The vessels thus formed are placed in cases, called gazettes, and placed in the oven to undergo the first baking. The heat employed in this baking is only carried to about 40 or 50 degrees of Wedgewood's pyrometer; that being sufficient for evaporating all the water contained in the paste.

The china is then in a state to receive its first coating, being very porous, and having the property of absorbing water, and of suffering it to evaporate through it;

indeed it is a true alcarazza, and might be used for cooling liquids.

The first glazing that is applied is dull, light, and brittle, its parts having very little connexion. But after the china has received the first coat, the second glaze is added, which must be of a substance much more easily melted than the body of the ware; as otherwise, the vessel growing soft in the fire, would run the chance of having their forms destroyed by their own weight bearing them down.

This second glazing is usually made of very finely pulverized felspar, reduced to a slip by water mixed with a little vinegar. The ware having received its first glazing is dipped in the felspar slip, until all its parts are equally covered; and the ware is then put into cases, and exposed to fire for thirty or thirty-six hours, when the china may be properly said to be made.

There are two kinds of China made at Vienna, the one hard, the other soft. The hard china is composed of much silica, a little alumina, and a very little lime. The soft China has had much carbonate or sulphate of lime added to it, and even a little potasse, or felspar, which contains potasse, in order to economise the firing. This sort of china, on account of its being easily melted, cannot be glazed with felspar; and is, therefore, glazed with a mixture of sand and oxide of lead. Its quality is inferior to that of the hard, but its glaze is smoother.

The painting of the china is done in two different ways, either under or over the glazing. *ib.*

NEW WARLIKE MISSILE.

Sir,—I shall be happy to suggest, for the opinion of your readers, through the medium of your widely circulated Magazine, a plan for rendering more formidable our ships of war in close fight, and for protecting the walls of fortresses against the danger of scalade. Every one must be acquainted with the destructive nature of shells thrown from military engines, and the dreadful effect an explosion causes among the enemy. In close actions at sea they can scarcely be used at all, and, unless they explode the moment they reach the enemy's deck, they can be thrown overboard; and when thrown from the walls of fortresses, an enemy can generally avoid their effects by throwing himself upon the ground before an explosion takes place. Guns cannot be so pointed as to annoy an enemy much just under the walls; it is, therefore, desirable to invent some instrument of war to supply these defects, and I humbly conceive that the following drawing and description may not be uninteresting to your readers.

NAUTICUS.

Description.

B is a charged shell, of a pear form, fastened by its minor extremity to a handle of wood six or eight feet long. C is a tube full of holes inserted in the shell, and extending from one extremity to the other, charged with powder. D is a powder on the percussion principle, fastened to its lower surface by any simple contrivance. When used, nothing more is wanted than to hurl it with precision to the spot wanted, either from the walls of a city or the main-mast of a ship. It must fall by its own gravity on the point, *d*, when it will instantly explode, and it would produce effects amongst the troops which may be more easily conceived than described.

Lond. Mec. Mag.

SIR WILLIAM CONGREVE'S MOVEABLE BALL-CLOCK.

The *cognoscenti* in elegant mechanism have long been in the habit of admiring a beautiful timepiece, which bears Sir Wm. Congreve's name, in which the minutes are indicated by the descent of a brass ball along a number of incined planes, running alternately from right to left, and left to right, on the face of an inclined brass plate. When the ball reaches the bottom of the plate, after having described the last of the inclined planes, it releases a detent, which tilts the brass plate and inclines it in the opposite direction. The ball being now at the top of the system of inclined planes, commences its retrograde motion, and when it again reaches the bottom, the plate is again tilted at the opposite position.

This clock was invented (as Dr. Brewster states in his last Quarterly Journal of Science) by M. Serviere, and is minutely escribed, in various forms, in a French rk entitled, "*Recueil d'Ouvrages Cu-*
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ibed, which is a very import-
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ib.

IVES FROM SHIP-

Sir,—I herewith sen
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If time and the circumstances of the case will admit, the end of a three and a half or four inch hawser should next be hauled off; this the crew must secure just above the tail-block, which should be either at the mast-head, bowsprit-end, or most elevated part of the hull, as the master may deem most advisable, in which he will be guided by the state of the mast, bowsprit, &c. always remembering that the higher it can be placed, under the lower mast-heads, with safety, the better. This hawser is to be rove through a single block, strapped, with two grommets under it, just long enough for a man to sit in each, holding on below the block. When the end of the hawser is fast on board, this block is to be hauled off by one part of the whip, and two men may get into the grommets, and be hauled on shore by the other part; the block, &c. being thus hauled to and fro, as often as it may be necessary to bring the whole crew on shore. At all stations having a flat beach, a strong triangle should accompany the apparatus, for the purpose of raising the hawser on shore with a snatch block for it to traverse in; and the in-shore end of the hawser, being previously rove through the ring of a small anchor, must be kept in hand, so as to ease it occasionally to the motion of the vessel, and to keep the crew as much out of water as possible in their passage from the wreck.

This plan is not given as original, nor is it merely theoretical; it has been partially practised with success under some of the most trying circumstances of shipwheck; and a descriptive plate verysimilar, though not adapted to the mortar, may be seen in the Naval Chronicle for January, 1800.

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NAUTICUS.

A

...n, H; *e*, a valve in the pis-
to admit the water from
the pipe, B, in order to
... the piston, H. The
... machine consists in
... he valves, *r* and *s*.
Descript... *r*, and the water
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fastened by its minor ext... through the
dle of wood six or eight feet ... valve, *s*, with
tube full of holes inserted in ... ater will de-
extending from one extremity ... l form a va-
charged with powder. D is a ... nsequently,
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ib.

PLANS FOR SAVING LIVES FROM SHIPWRECK.

SIR,—Seeing the description or Mr. Bell's invention for saving lives from shipwreck, in the Mechanics' Magazine, and knowing how necessary it is that some general plan should be adopted for giving this valuable invention its full effect, I am induced to request your insertion of the following scheme, adapted to the mortar plan, for the purpose of bringing the crews of stranded vessels on shore, after the rope of communication has been thrown over the wreck.

The rope thrown from the mortar should not be less than two-inch, which one of Bell's mortars, having its chamber bored to contain twenty ounces of powder, would throw from 250 to 300 yards. The moment this is received on board, the crew should reeve the end through a tail block, and haul off as much as will be sufficient for the end and bight to go on shore again, in which they may be guided by a seizing or stop, seized on by the people on shore for that purpose; when this stop reaches the block, the end is to be be secured to it, and both parts being hauled on shore, a singlewhip-purchase will be formed, by which the people on shore may haul off whatever the situation of the wreck may render most advisable for bringing the crew on shore.*

If time and the circumstances of the case will admit, the end of a three and a half or four inch hawser should next be hauled off; this the crew must secure just above the tail-block, which should be either at the mast-head, bowsprit-end, or most elevated part of the hull, as the master may deem most advisable, in which he will be guided by the state of the mast, bowsprit, &c. always remembering that the higher it can be placed, under the lower mast-heads, with safety, the better. This hawser is to be rove through a single block, strapped, with two grommets under it, just long enough for a man to sit in each, holding on below the block. When the end of the hawser is fast on board, this block is to be hauled off by one part of the whip, and two men may get into the grommets, and be hauled on shore by the other part; the block, &c. being thus hauled to and fro, as often as it may be necessary to bring the whole crew on shore. At all stations having a flat beach, a strong triangle should accompany the apparatus, for the purpose of raising the hawser on shore with a snatch block for it to traverse in; and the in-shore end of the hawser, being previously rove through the ring of a small anchor, must be kept in hand, so as to ease it occasionally to the motion of the vessel, and to keep the crew as much out of water as possible in their passage from the wreck.

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wreck to the shore, where it may be impracticable *from the shore* to the wreck.*

Let two small casks be connected by a going through one head of each, having its ends secured to the inner centres of the other heads, and leaving a distance between the casks of rather more than the length of one of them. The spar will then represent an axle, and the casks two wheels firmly fixed to it, and made water-tight. Upon this axle a line is to be reeled, in the manner of a log-line, and when thrown overboard, with one end of the line fast to the ship, the power of the wind and sea will keep the casks in continual revolution, until the buoy reaches the shore; and it will be found, that as the line unreels only as the casks revolve, there is little danger of the bight getting far into the undraught. This might be entirely prevented by making the line buoyant.†

A buoy of this description might be constantly kept slung over the stern or quarter of any vessel at sea, ready for cutting away at a moment's warning, either for the purpose of saving the crew from a wreck, or as a life-buoy, in case of a man falling overboard; and in the event of a ship being stranded on a bar or bank, at a distance from land, where boats cannot get alongside the wreck, this buoy being cut away, would carry a line from the ship to a boat, by which means a communication would be formed, which might ensure the safety of the crew.

I am, sir, your obedient
Humble servant,
NAVARCHUS.

January 21st, 1825.

ib.

* Rockets have been recommended to be supplied to ships, for the purpose of carrying a line on shore, and I have no doubt they would, in many casss, have the desired effect.

† In the 32nd volume of the Transactions of the Society of Arts, is an account of Mr. Cleghorn's invention of a buoyant line; and a life buoy, or boat, invented by Mr. T. Boyce.

ECONOMY IN FIRE WOOD.

The size into which wood should be split, so as to be durable in burning, and yet give sufficient heat, is a matter worthy of some consideration. If split very small, any given quantity will give more heat for a while, but will be quickly consumed; if large, it will consume slowly, but will burn less readily, and give much less heat. A fire composed of billets of wood not more than fourteen inches long, will give more than two-thirds as much heat as that made of wood double that length. Perhaps billets of from three to four inches, of a medium diameter, will be found the most economical, as avoiding the two extremes. *ib.*

HOW TO PREVENT STOVE-PLATES FROM BREAKING.

SIR,—In my walks through the metropolis, I happened to cast my eye upon a very antiquated moving grate, which perplexed me for a considerable time, endeavouring to unravel the mystery; for I apprehend a mystery is fudge as long as it is unintelligible, and then it is no mystery.—The mystery in question is, the metal back of the grate being perforated all over with holes, about three-quarters of an inch diameter each. The broker being applied to for an explanation, supposed the object was to diffuse heat in that direction, should the grate be drawn into the middle of the room—"And with the heat," rejoined I, "much dirt and smoke."

Now, sir, the *eclaircissement* is this—the holes permit the back to expand when hot, and thereby prevent its breaking.—The practice, though obsolete, is worthy of being revived.

I am, sir, your obedient
Humble servant,
T. HARTSHORNE.

January 19th, 1825.

ib.

Communications for the American Mechanics' Magazine, Post paid, and addressed to

JAMES V. SEAMAN,

Broadway, New-York, will receive due attention.

William Van Norden, Printer.